ZOOLOGICAL SCIENCE 7: 303–309 (1990)

Early Larval and Postlarval Morphology of the Soldier Crab, *Mictyris brevidactylus* Stimpson (Crustacea: Brachyura: Mictyridae)

YASUSHI FUKUDA

Biological Lobaratory, Faculty of Education, Kumamoto University, Kumamoto 860, Japan

ABSTRACT—The first zoea and megalopa of *Mictyris brevidactylus* are described and illustrated. Their relationships with those of *M. longicarpus* are discussed. The megalopa is unique in having a whorl-like arrangement of setae on the top of the antenna which possibly represents one of the diagnostic characters of either *Mictyris* or Mictyridae.

INTRODUCTION

The soldier crabs, familiar to us especially because of their habits of aggregation on sandy mud flats during low tide, belong to the genus *Mictyris* which is now known to accommodate four species [1, 2]. A Japanese species, *Mictyris brevidactylus,* was first described by Stimpson [3] based upon materials collected from the Ryukyu Islands and Hong Kong, but it has long been considered identical with *M. longicarpus* from Australia [4]. Yamaguchi [5] suggested that there may be ecological, and therefore taxonomic differences between Australian and Japanese populations. Most recently, in his revisionary work of the genus *Mictyris,* Takeda [2] concluded that the Japanese and the Australian forms were specifically different.

The purpose of this study is to provide detailed descriptions of larval and postlarval morphology of *M. brevidactylus,* and to discuss the taxonomic status of the Japanese soldier crab from the viewpoints of larval and postlarval morphology.

MATERIALS AND METHODS

Ovigerous females of *M. brevidactylus,* collected on Amamin-ōshima of the Ryukyu Islands, February 22, 1978, were transported to Kumamoto and reared under laboratory conditions. First zoeas hatched on March 11; but all of them died during the preparation of food supply; the first zoeas were fixed with 50% ethylene glycol for examination. The megalopas here used were collected from the same locality by Dr. T. Yamaguchi on March 1, 1973, and by myself on February 22, 1978. The collected samples of the megalopas are referable to *M. brevidactylus* because of their habitat, and morphology, particularly of the whorl-like arrangement of setae on the top of the antenna as displayed by the Australian *M. longicarpus* [7]. All the specimens were preserved in 75% (ethyl) alcohol. The setation of each appendage is presented from proximal to distal.

Description of first zoea

Size.—Carapace length (distance between tip of rostral spine and posterior margin of carapace) 0.71–0.73 mm (average 0.72 mm): 10 specimens examined.

Carapace (Fig. 1A, B).—Smooth, inflated and globose; lateral and dorsal spines absent; rostral spine overreaching antenna, bearing row of fine setae distolaterally; eyes immovable.

Abdomen (Fig. 1A).—Five somites and telson; somite 1 completely concealed beneath carapace; somite 2 with anteriorly directed lateral process; remaining somites each with small posterolateral

Accepted june 7, 1989
Received January 8, 1989

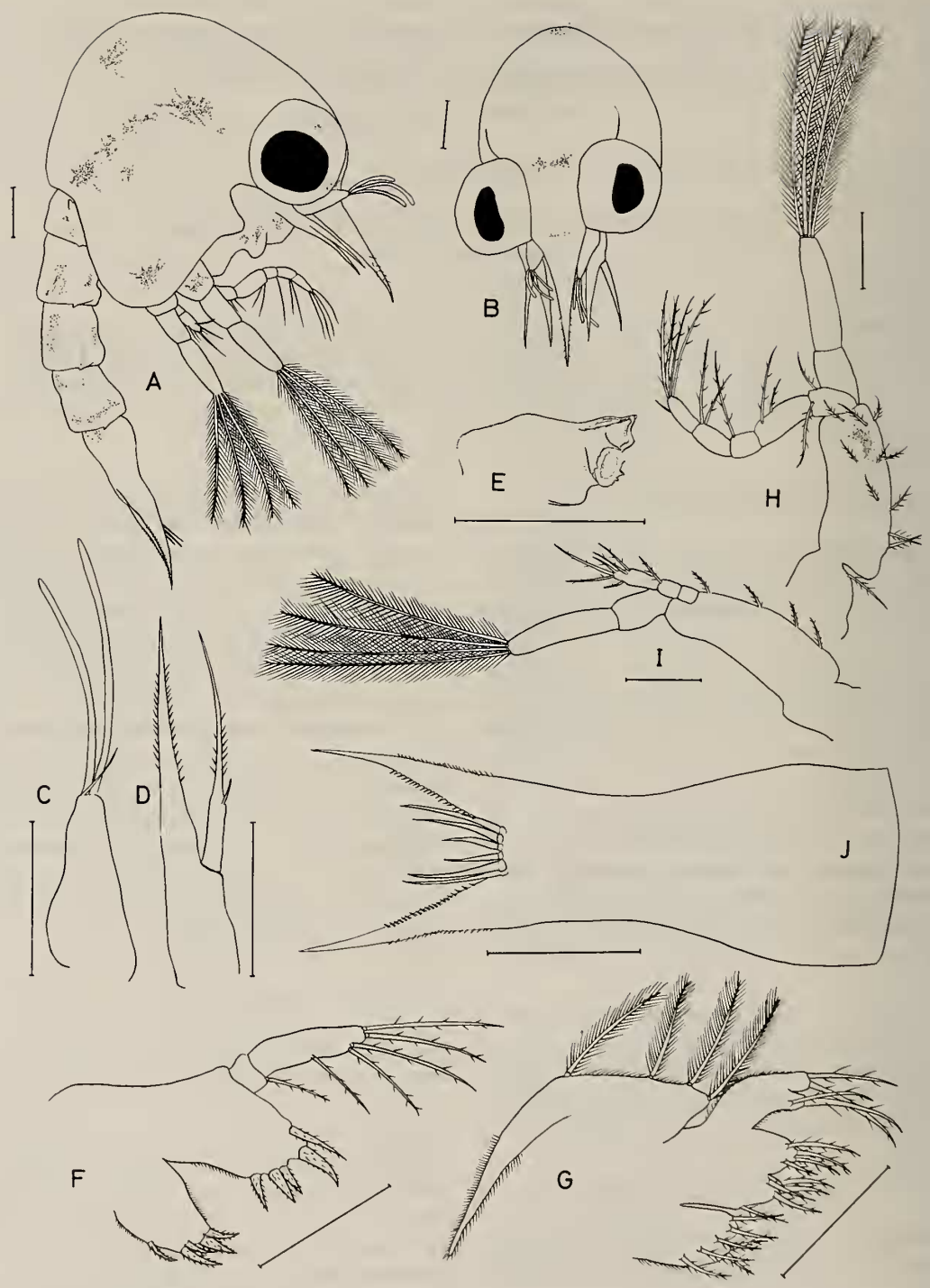

FIG. 1. First zoea of *Mictyris brevidactylus* Stimpson. A, lateral view; B, frontal view; C, antennule; D, antenna; E, mandible; F, maxillue; G, maxilla; H, first amxilliped; I, second maxilliped; J, telson. Scales, 0.1 mm.

spine.

Telson (Fig. 1A, J).—Elongate, medially constricted; furcae slightly curving dorsal, bearing numerous tiny spines on mesial margin and fine setae on lateral margin; posterior margin bearing 6 simple elongate setae.

Antennle (Fig. 1C).—Rod-like, somewhat inflated basally; 2 long aesthetascs and 1 short seta.

Antenna (Fig. 1D).—Protopodal process elongate, bearing a row of spinules on mesial and lateral margin; exopod falling short of end of protopodal process, with 1 spinule at 1/3 of length from proximal end; plus numerous setae mesially and laterally.

Mandible (Fig. 1E).—Molar process short and subcylindrical, with denticles of irregular size; incisor process bluntly bidentate.

Maxillule (Fig. 1F).—Endopod 2-segmented, proximal segment short, 1/4 as long as distal segment, with 1 distolateral seta; distal segment with 1 midlateral, 2 subterminal, 2 terminal setae; coxal and basal endites bearing 5 setose spines each; other pubescence as illustrated.

Maxilla (Fig. 1G).—Endopod distally bifurcate with 2 terminal, 2 subterminal setae; distal and proximal lobes of basal and coxal endites, bearing 4, 5 and 2, 5 setae respectively; scaphognathite with 4 soft plumose setae plus 1 stout, apical plumose projection; fine hairs on margins of endopod, coxal endite and scaphognathite, as illustrated.

First maxilliped (Fig. 1H).—Endopod 5-segmented, with setation of 2, 2, 1, 2, 4+I; exopod 2-segmented, with 4 natatory setae; basis elongate, subcylindrical, bearing 4 groups of setae (2, 2, 3, 3), progressing distally 10 in all as illustrated; coxa with 1 seta.

Second maxilliped (Fig. 1I).—Three-segmented endopod relatively short, about half as long as exopod, with setation of 0, 1, 2+3+I; exopod 2-segmented, with 4 natatory setae; basis elongate and subcylindrical with 4 equidistant setae; coxa naked.

Chromatophores (Fig. 1A, B).—Located at base of rostrum, between eyes, carapacial center, cardiac and postcardiac regions, labrum, mandible, basis of first maxilliped, second through fifth abdominal somites and telson. Color not noted.

Description of megalopa

Size.—Carapace length 1.72–1.81 mm (average 1.77 mm); carapace width 1.41–1.48 mm (average 1.45 mm): 5 specimens examined.

Carapace (Fig. 2A-B).—Posteriorly widened, dorsally convex; 2 tubercular processes on gastric region, each fringed with setae posteriorly; median rostral process very short and strongly deflexed, lateral processes small, directed upward, each with one terminal seta; postero-lateral margin of carapace setiferous; orbit rather shallow; buccal cavern large, nearly trapezoidal.

Thorax and *pereopods* (Fig. 2A, C, E, F).—Sixth and seventh sternal segments with tubercular process near lateral margin. Pereopods sparsely setose; chelipeds relatively slender, stouter but distinctly shorter than the three walking legs; walking legs somewhat compressed laterally, first leg longest, fourth leg reduced in size, with 5 long branchyuran feelers.

Abdomen (Fig. 2B, D).—Six somites and telson; dorsal surface sparsely setose as illustarted; somites 2–4 with 2 small posterolateral spines on each pleuron; pleuron of somite 5 with single large, acute, posteriorly directed spine; somite 6 unarmed, about half as long as telson.

Pleopods (Fig. 2B, D).—Decreasing in size on somites 2–6; expods of somites 2, 3, 4 and 5 bearing 18, 18, 18, and 15 natatory setae, respectively; endopods each with 3 small terminal hooks; uropod with 5 long plumose setae.

Antennule (Fig. 3A).—Four-segmented; proximal segment markedly inflated, with 2 lateral spine-like setae; second segment with 1 short lateral seta; third segment with 2 setae at articulation; 6 aesthetascs, 1 subterminal seta on fourth segment.

Antenna (Fig. 3B).—Five-segmented; penultimate segment bearing whorl of 16–18 long setae as illustrted.

Mandible (Fig. 3C).—Incisor process with dentate cutting edge; molar process smooth, not toothed; mandibular palp 3-segmented, ultimate segment with 9 short setose spines on distal half.

Maxillule (Fig. 3D).—Endopod unsegmented with 1 terminal and 2 lateral setae; basal and coxal endites with numerous spines and setae; a long plumose seta at base of endopod.

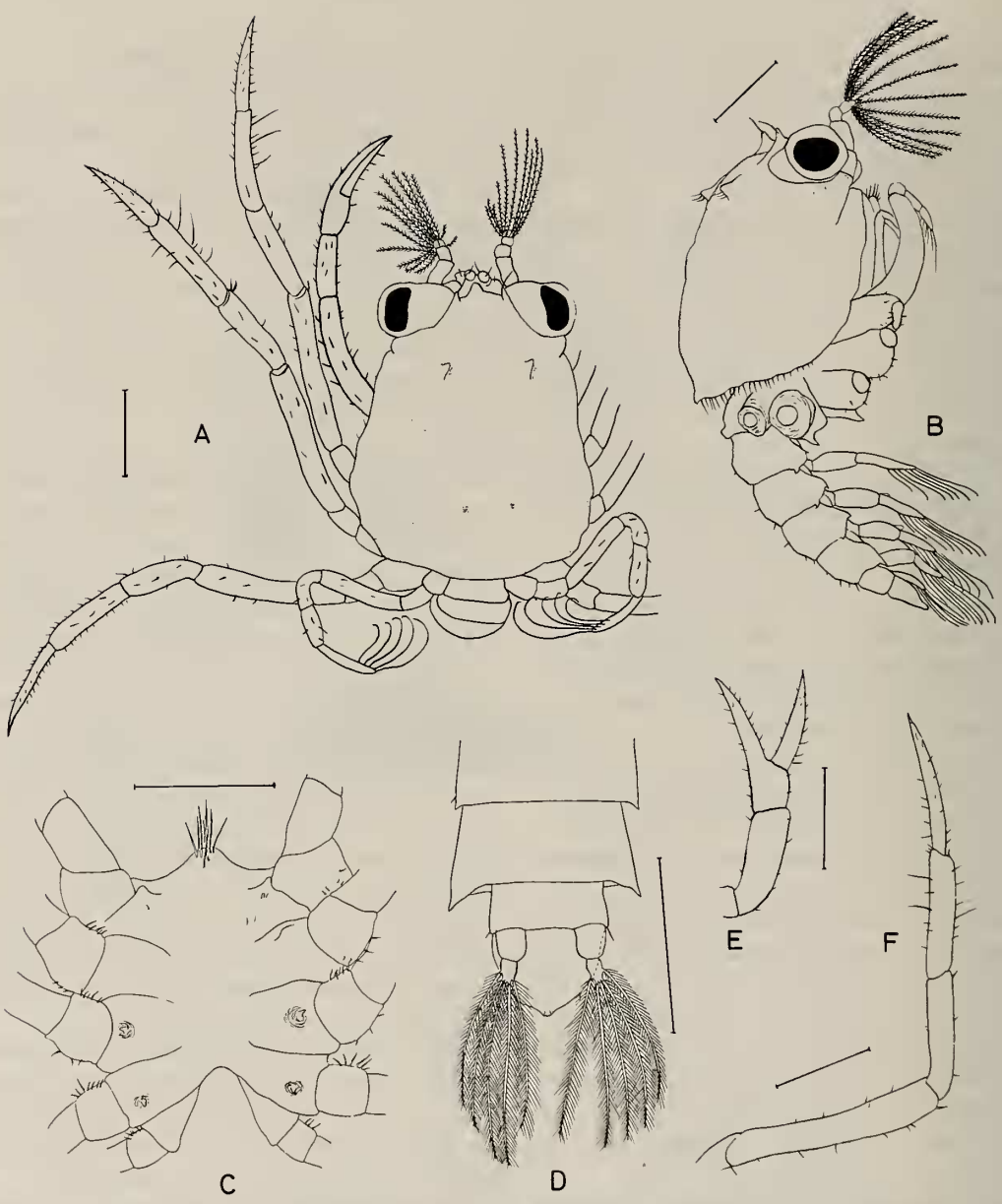

FIG. 2. Megalopa of *Mictyris brevidactylus* Stimpson. A, dorsal view; B, lateral view; C, thoracic sternum; D, posterior half of abdomen and tail fan; E, right chela, interior view; F, right second walking leg, interior view. Scales, 0.5 mm.

Maxilla (Fig. 3E).—Endopod unsegmented, bearing 3 proximal marginal setae; scaphognathite well developed, fringed with 58–62 plumose setae; basal and coxal endites bilobed, distal and proximal lobes bearing 12, 9 and 9, 23–24 spine-like setae respectively.

First maxilliped (Fig. 3F).—Exopos and endopod apparently unsegmented: exopod with 2 long plumose setae at 1/3 of length from distal end, terminal margin with 1 setal nub; endopod without setae but with 2 setal nubs at distal end; epipod roughly triangular, bearing a total of 5 plumodenticulate

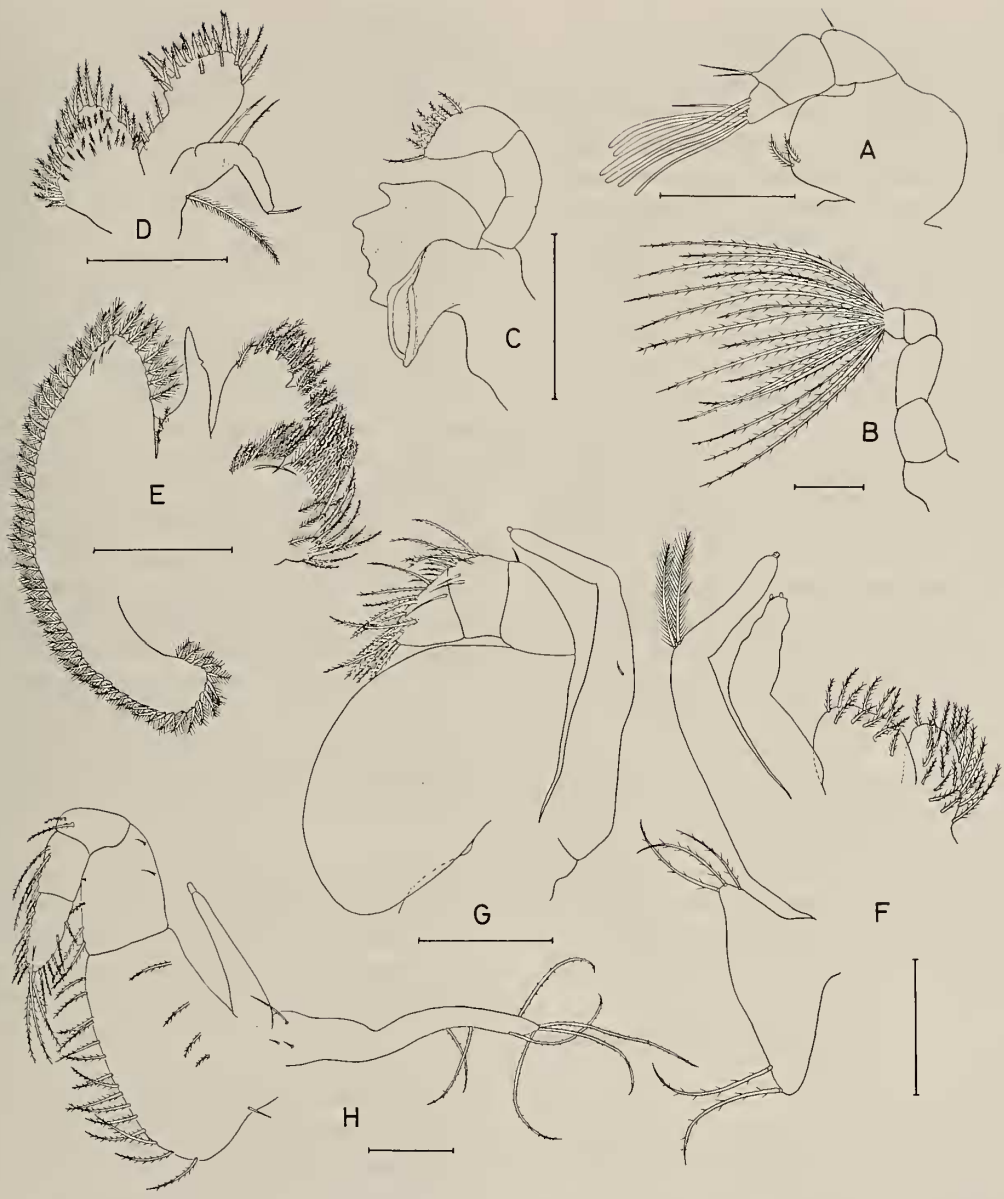

FIG. 3. Megalopa of *Mictyris brevidactylus* Stimpson. A, antennule; B, antenna; C, mandible; D, maxillule; E, maxilla; F, first maxilliped; G, second maxilliped; H, third maxilliped. Scales, 0.2 mm.

setae at corners, as illustrated.

Second maxilliped (Fig. 3G).—Exopod unsegmented with 1 setal nub at distal end; endopod 4-segmented, segment 1 (proximal) very broad and foliaceous naked; segments 2, 3, 4 bearing 1, 8, 15–17 spine-like setae respectively; epipod absent.

Third maxilliped (Fig. 3H).—Exopod reduced in size, terminal margin with 1 setal nub; endopod 5-segmented, with setae as shown; narrowed distally, ischial segment elongate, fully twice as long as meral segment; epipod well developed with several long setae on distal 1/3 of length.

DISCUSSION

Based upon adult morphology, Takeda [2] revised the genus *Mictyris* and concluded that the Japanese and Australian soldier crabs, both previously merged with *Mictyris longicarpus,* are specifically distinct and that the Japanese species should be called *M. brevidactylus* Stimpson. These two species, however, are not remote in distribution. The southern limits of their ranges are rather close, the boundary being placed roughly between the vicinity of the Sulu Sea and the south of the Philippines [1]. Notwithstanding their close range, ecological differences, especially in tunnel feeding habits and wandering activity patterns, have been noted [5]. In addition to these data, the differences between *M. longicarpus* and *M. brevidactylus* are also distinct from the viewpoint of larval and postlarval morphology.

Cameron [6] briefly described the first zoea of *M. longicarpus* obtained from females collected from Moreton Bay, Southern Queenslnad. Fielder *et al.* [7] provided definitive descriptions of the 5 zoeal stages of that species obtained by rearing, and of megalopas collected on the same shore of Moreton Bay, and thus modified Cameron's definition of the larvae of the species in several respects.

The present data are compared with those of Fielder *et al.* Listed below are the morphological differences in the first zoeas and megalopas between *M. longicarpus* and *M. brevidactylus.*

	M. longicarpus	*M. brevidactylus*
FIRST ZOEA		
Exopod of antenna	1 short seta at midlength	without seta
Coxal endite of maxilla	7 spines	6 spines
Basis of first maxilliped	9 spines	10 spines
MEGALOPA		
Molar process of mandible	absent	present
Distal segment of mandibular palp	8 spines	9 spines
Endopod of maxilla	without seta	3 proximal marginal setae
Exopod of third maxilliped	1 plumodenticulate seta	without seta
Hair formula of uropod	0–6	0–5

These differences are sufficient to warrant the Australian and Japanese populations to be regarded as distinct species. Thus, zoeal and megalopal morphology fully complements the work by Takeda [2] on adults.

The oval, dorsally rounded carapace, the strongly deflexed rostrum, and the very wide buccal cavern containing largely foliaceous endopods of the second and third maxillipeds and slenderly reduced exopods of three pairs of maxillipeds, are very characteristic of megalopa in the genus *Mictyris.* The last two of these seem to be related to the feeding habits, *i.e.* the making of sand pellets during feeding. A similar situation is seen in the megalopa of the ocypodid crab *Scopimera globosa* [8].

The exopod of the third maxilliped in *M. brevidactylus* lacks a flagellum, whereas that in *M. longicarpus* has a distinct plumodenticulate seta which, however, is possibly lost in the next juvenile stage, for the absence of the flagellum represents one of the familial characteristics of the Micytridae [4, 8].

The antennal whorl of setae, which is shared by the megalopas of both the Japanese and the Australian species of *Mictyris,* has not been recorded in postlarvae of other brachyuran crabs. Very possibly it represents either a generic or a familial characteristic, though no information is available on the two other known species of this genus.

ACKNOWLEDGMENTS

I thank Dr. K. Baba of Kumamoto University and Dr. R. H. Gore, Bio-Econ, Incorporated, Naples, Florida, for reviewing a draft of the manuscript. Thanks are also due to Dr. M. Takeda of the National Science Museum, Tokyo, for his advice regarding systema-

tic treatment of *Mictyris*. I am obliged to Dr. T. Yamaguchi of the Aitsu Marine Biological Station, Kumamoto University, for making specimens of *M. breavidactylus* available for study. I acknowledge Dr. Y. Miya of Nagasaki University and Dr. Y. Nakasone of the University of the Ryukyus, for preparing copies of references at my request. I am also grateful to the anonymous reviewers for making helpful comments on the manuscript.

This study was supported in part by a grant-in-aid from the Ministry of Education, Science and Culture of Japan, No. 57340036.

Contribution No. 52 from the Aitsu Marine Biological Station, Kumamoto University.

REFERENCES

1 McNeill, F. A. (1926) Studies in Australian carcinology. No. 2. Rec. Aust. Mus., **15**: 100–131, pls. 9–10.

2 Takeda, M. (1978) Soldier crabs from Australia and Japan. Bull. Natn. Sci. Mus., Ser. A (Zool.), **4**: 31–38.

3 Stimpson, W. (1858) Prodromus descriptionis animalium evertebratorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladaro Ringgold et Johanne Rodgers Ducibus, observavit et descripsit. Pars V. Crustacea Ocypodidea. Proc. Acad. Natl. Sci. Phila., **10**: 93–110.

4 Sakai, T. (1976) Crabs of Japan and the adjacent seas. Kodansha, Tokyo. (In 3 volumes: (1) English text, xxix+773 pp. (2) Plates volume, 16 pp., 251 pls. (3) Japanese text, 461 pp.)

5 Yamaguchi, T. (1976) A preliminary report on the ecology of the sand bubbler crab, *Mictyris longicarpus* Latreille. Benthos Res. Jap., **11/12**: 1–13. (In Japanese with English abstract)

6 Cameron, A. M. (1965) The first zoea of the soldier crab *Mictyris longicarpus* (Grapsoidea: Mictyridae). Proc. Linn. Soc. N. S. W., **90**: 222 –224.

7 Fielder, D. R., Greenwood, J. G. and Quinn, R. H. (1984) Zoeal stages, reared in the laboratory, and megalopa of the soldier crab *Mictyris longicarpus* Latreille, 1806 (Decapoda, Mictyridae). Bull. Mar. Sci., **35**: 20–31.

8 Ono, Y. (1965) On the ecological distribution of ocypodid crabs in the estuary. Mem. Fac. Sci., Kyushu Univ., Ser. E (Biol.), **4**: 1–60.